



Selection, Testing, and Effectiveness in the Field of PPE and Gloves

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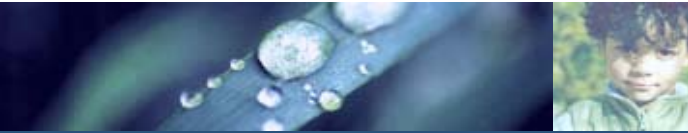


Better than PPE:

- **Avoid skin contamination
(technique, process, education)**

BUT

- **This not always possible, esp. not
at non-permanent workplaces
(construction trade, shipyards, etc.)**



Chemical Protective Clothing and Gloves

- Selection of CPC not as easy as we all would it love to be
- Purchase of CPC is often hindered by high costs
- Implementation is often hindered by low comfort or low dexterity



Production of CPC

Criteria for Design of CPC and Gloves:

- **Availability of the material**
- **Price**
- **Comfort**
- **Mechanical stability**
- **Barrier Effect**



Production of CPC

Documentation of Barrier Effect :

- Against a list of chemicals

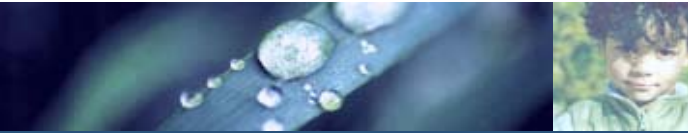
OR

- Against the chemicals in use
- Difficult to predict from one chemical mixture to the next



Mixtures, Preparations

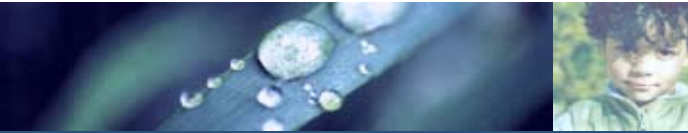
- **Prediction from single substance data to behavior of mixture – often impossible**
- **Special case: Solutions of large molecules: The solvent determines breakthrough**
- **"Opening" or carrier effect**



Purchase of CPC

Criteria for Purchase of CPC and Gloves:

- Price
- Price, Price
- Comfort, dexterity
- Barrier effect (Quality of information?)
- Duration of use



Select Polymer or Brand?

Within one polymer there are significant differences in:

- **Thickness**
- **Raw materials, polymer mixtures**
- **Vulcanizing technique, cross-bonding**
- **Polymer layers within glove**



Select Polymer or Brand?

Latex does not equal Latex,

Nitrile does not equal Nitrile

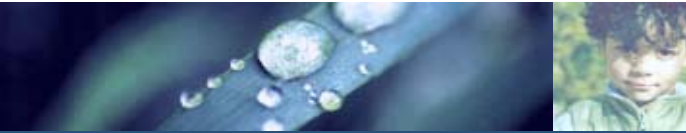
**Each test is valid only for the glove brand,
not for the generic type of polymer !**



Re-Use of Gloves next Day ?

Sometimes YES – sometimes NO

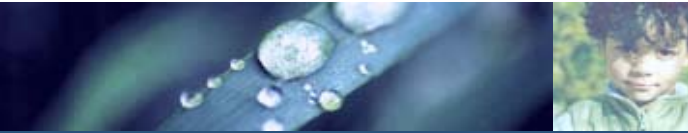
Real Protection Time			
Case No	1 st day	2 nd day	3 rd day
1	> 8 h	> 8 h	> 8 h
2	2 h	1 h	1 h
3	1:20 h	1 h	1 h
4	1:40 h	—	—
5	1:30 h	—	—
6	0:50 h	—	—



Today's Quality of Selection

Test results vs. recommendations

- **3 out of 5 cases: gloves in use and recommended by supplier: permeable**
- **4 out of 5 cases: detailed recommendations, cheaper than proposals from most databases**
- **Laminate gloves (4H, Barrier): very good in all tested cases, but bad acceptance (low wearing comfort)**



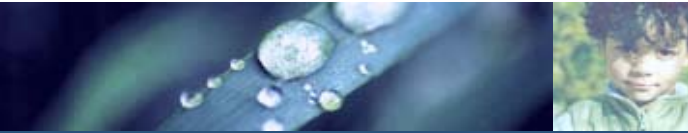
Contamination inside CPC

- **Inside contamination was observed by measurements**
 - **Using adsorbent pads or clothing**
 - **Using indicator strips**
 - **Using wipe or flash samples after exposure**



Contamination inside CPC

- **Contamination from surfaces when not worn**
- **Contamination from CPC when taking off / on**
- **Contamination through cuff**



Contamination inside CPC

- **Penetration - through holes**
- **Degradation - chemical "resistance"**
- **Invisible permeation - on molecular level**



Breakthrough Time

- **Period until permeation of 1 μg / 0.1 μg substances per minute through 1 cm^2 glove area is reached (EN / ASTM)**
- **Precision / variation:**
 - \pm 5 - 30 % within a lab**
 - \pm 23 - 50 % between labs**
 - \pm 8 - 25 % between trained labs**

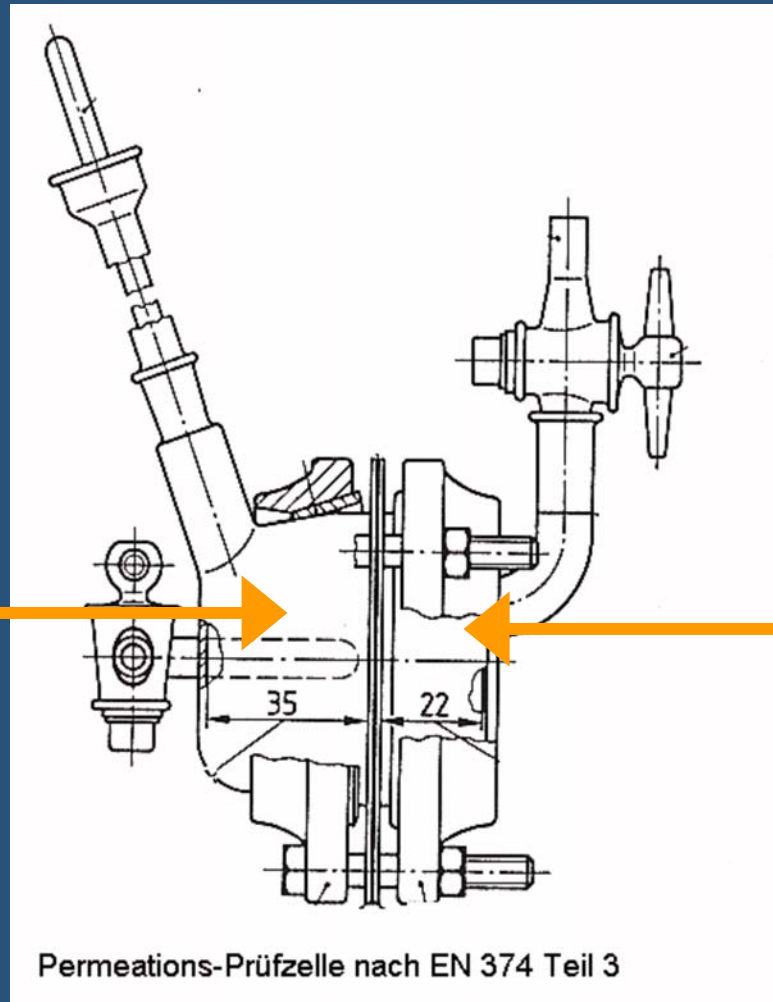


Breakthrough Time = Protection Time ???

- Selection of test method
- Standard test with test cell
ASTM F739 / EN 374-3 / ISO 6529



Permeation



Chemical

Air or Water



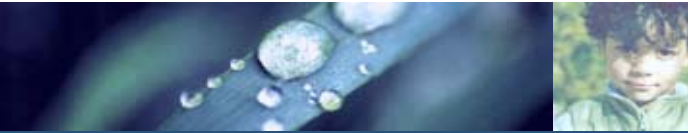
Don't trust all results

- **Example:**
Old dried products containing PAH
- **Not detectable by standard method**
- **Hypothesis: No breakthrough because molecules are too large**
- **Testing with paraffin wetted glass fiber filters: 1 out 4 gloves showed breakthrough**



Holder for solid sampling





Breakthrough Time = Protection Time ???

- Selection of test method
- Conditions of testing



EN 374-3 Testing Standard

"It is emphasised that the test does not represent conditions likely to be found in service,

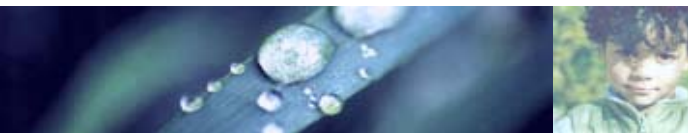
and the use of test data should be restricted to comparing materials chiefly on a relative basis in broad categories of breakthrough times."



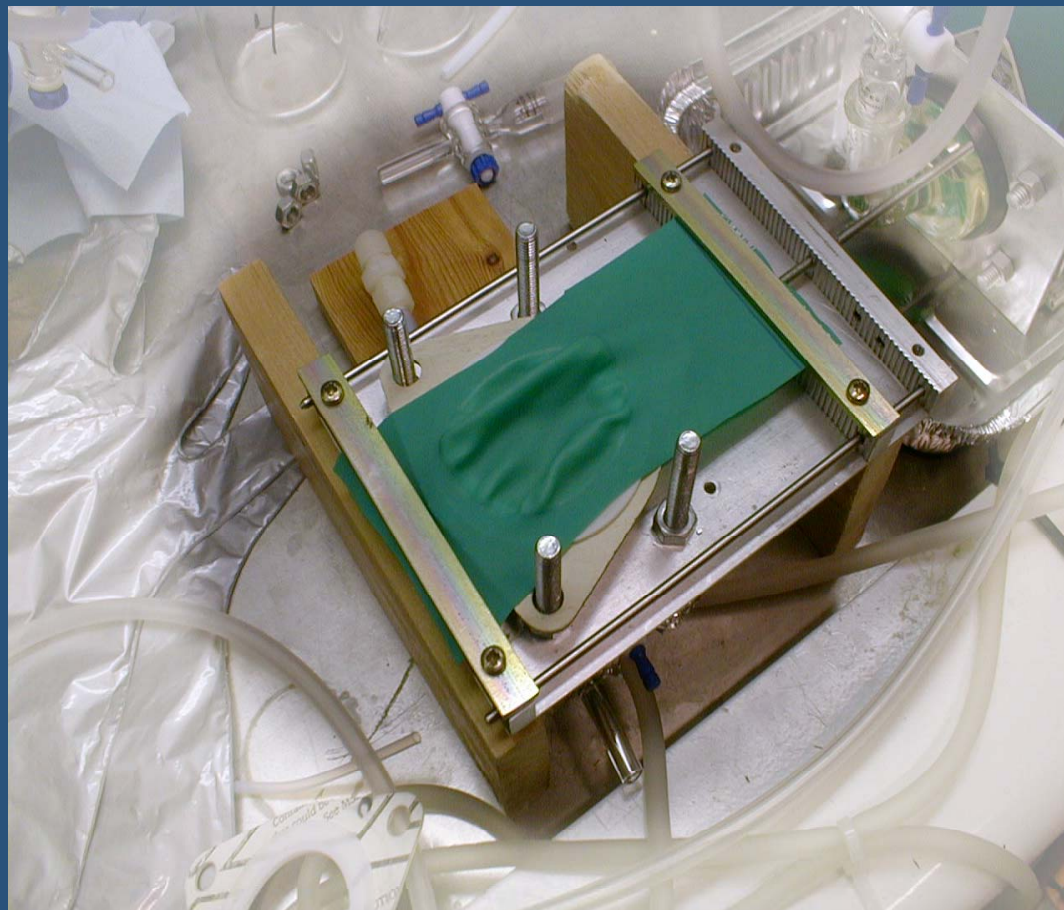
Temperature and Stretching

Conditions of testing:

- Temperature inside glove: 35 °C
- Stretching of gloves
 - Length stretching - typically 20 % at finger knuckle
 - Interval stretching or continuous stretching



Stretching during test





Temperature and Stretching

35 not 23 °C, 20 % Length stretching

Glove	Chemical	Reduction of Breakthrough Time
Type Nitrile	non polar	by 0 - 50 %
Type Butyl	different	by 50 - 70 %
Type Chloropren	polar	by 30 - 50 %



Short-term Exposure

- Exposure of small areas only
- Occasional splashes
- Only temporary exposure
 - e.g. once a day
 - in intervals several times a day

Volatility determines the period of the agent remaining on glove and its impairment



Conclusion

- **Poor significance of many published data**
- **Always refer to a specific brand**
- **Update the testing standard**
- **Consider temperature and use patterns**
- **Use appropriate detection method**



Possibilities in the Future

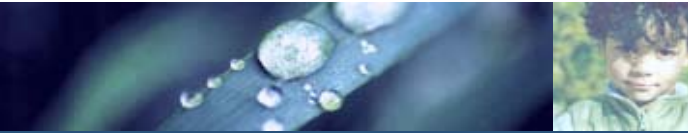
- Trade specific recommendation of glove brands
- Suppliers of hazardous chemicals inform about good glove brands for typical use patterns
 - in MSDS / technical data sheet / example risk assessment
- All this with realistic testing (35 °C, possibly adapted duration of test)



What can we do TODAY ?

- **Avoid skin contact**

- **Define specifications for the CPC or glove**
 - **Exposure**
 - **Duration**
 - **Use patterns**
 - **Re-use**



What can we do TODAY ?

- **If hazard is low:**
 - **Use comfortable CPC or gloves but only when exposure is high**

- **If hazard is high:**
 - **Use high performance CPC or gloves**

 - OR**
 - **Use cheap gloves and substitute immediately after any short exposure occurred**



What can we do TODAY ?

- For selection of high performance CPC or gloves: ask supplier or independent experts
- Select, buy and use the CPC or gloves
- Organize training and ensure proper use
- Make sure that other CPC is not purchased without prior knowledge of its performance



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For more detailed information:

www.eurofins.com